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# THE SPRUCE BUDWORM

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The color plate on the cover shows the eggs, larva, pupa, and adult of the spruce-fir form of the budworm, as well as its characteristic feeding. (Courtesy of the Division of Entomology, Science Service, Canada Department of Agriculture, Ottawa, Canada.)



# THE SPRUCE BUDWORM

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## A Serious Threat to Our Spruce-Fir Forests

Another serious outbreak of the spruce budworm (*Archips fumi-ferana* (Clem.)) is now occurring in the Provinces of Ontario and Quebec, Canada, and threatens the spruce-fir forests of New England, New York, and the Lake States. This outbreak in Canada attracted attention in 1937 and has since increased in area at an alarming rate. Surveys made by the Division of Entomology of the Dominion of Canada Department of Agriculture show that by 1943 about 90 percent of the balsam fir and 50 percent of the spruce had been killed on 12,000 to 15,000 square miles. In addition, an area estimated at 30,000 square miles now sustains a medium infestation where 5 to 10 percent of the timber has been killed. There are also other vast areas where light defoliation has been noted but where as yet little death of timber has occurred.

During the widespread outbreak of 1910-20 which occurred in Quebec, New Brunswick, Maine, and northern Minnesota, it was estimated that over 225 million cords of pulpwood was destroyed. The history of this outbreak is a constant reminder of the danger that exists throughout our northern forests when heavy outbreaks are in progress across the border. No outbreaks of this insect are known to occur at the present time in the spruce-fir forests of the northeastern part of the United States. A few adults were taken at light traps, however, and occasional larvae were seen in Maine during 1943.

A biological race of the spruce budworm which prefers jack pine occurs in the Lake States. This form has been causing noticeable defoliation in Minnesota for several years, and in 1943 heavy defoliation was observed on the Superior National Forest in that State.

Because of the possibility that some undetected outbreak may exist at the present time in this country, every effort should be made to survey thoroughly the spruce-fir and jack pine forests in the States bordering Ontario and Quebec. And because of the vast area involved, it will be necessary to enlist the help of all agencies which have men operating in the spruce-fir and jack-pine region and to supply these men with adequate information to enable them to recognize the insect, so that they may report their findings to the proper authorities. The purpose of this leaflet is to provide a description of the spruce budworm and of its feeding so that everyone interested in the preservation of our northern coniferous forests may become familiar with the characteristics of this dangerous enemy.

## The Spruce Budworm, Its History and Distribution

The spruce budworm is a native species and is found throughout practically the entire range of its food plants on this continent. In Maine serious outbreaks occurred about 1807 and again about 1878. The most serious outbreak on record began in Quebec about 1909, appeared in Maine in 1910 and in Minnesota in 1913, and continued its ravages for nearly a decade. About 1923 the budworm began to attract attention in the Lake States as a pest of jack pine. Several outbreaks have occurred in the western part of the United States on Douglas fir, alpine fir, white fir, Engelmann spruce, blue spruce, lodgepole pine, and ponderosa pine. A very extensive outbreak in Colorado is now causing considerable damage to all these species except lodgepole pine.

### Its Host Trees

In the Northeastern States, the Lake States, and eastern Canada, balsam fir is the favored food plant; in the Lake States and part of Ontario a biological race prefers jack pine and Scotch pine; in Colorado and the Northwestern States Douglas fir and alpine fir are attacked; in Montana a strain has been recorded on lodgepole pine; and in Colorado another biological race defoliates ponderosa pine. White fir, the several species of spruce, hemlock, and larch are attacked to a greater or less degree.

### The Nature of Its Injury

Upon emerging from hibernation in the spring the young larvae tunnel in the old needles and then bore into the opening buds on spruce or fir trees. Later they feed on the developing foliage and when about half-grown they begin tying the tips of two or more twigs together with silk, forming small nests. The new growth is preferred by the growing larvae and is entirely destroyed before the old foliage is eaten. Feeding usually begins at the top of the tree, and when the population is low it is difficult to detect the presence of the insect. In heavy infestations the trees exhibit a scorched appearance, later turning grayish as the foliage disappears, and finally dead tops of dying trees become evident. When the larvae become full-grown they may be jarred from the branches by striking the trunk of the tree several sharp blows with the head of an ax. A cloth mat placed on the ground beneath the trees will facilitate the finding of any larvae which may fall. This method may be employed for determining the relative population density in light to medium infestations to supplement estimates of percentage of defoliation.

Greatest tree mortality occurs in the red spruce-balsam fir type, particularly where fir predominates and is overmature. Little damage has been reported in mixed hardwood-spruce-fir stands, especially if the conifers are overtopped by the hardwoods. White and black spruce appear to suffer less from attack than red spruce and fir, apparently because the opening of the buds and foliage development of the former tree species do not synchronize with larval development as well as in the case of the latter species.



Injury to jack pine in the Lake States appears to be most severe in overmature or open-grown stands. Such trees produce an abundance of staminate flowers, which serve as food for young larvae before new foliage appears.

Where heavy outbreaks occur in the spruce-fir region, some trees die the first year after severe defoliation, mortality increases the second and third years, and some trees will die 5 or more years after the outbreak has subsided. Secondary insects and fungi may be instrumental in killing the weakened trees.

### **Description of Its Life Stages**

The egg, larva, pupa, and adult, as well as the characteristic feeding, of the spruce-fir form of the budworm are shown in the colored illustration on the cover. The moth has a wing expanse of seven-eighths inch and in general is grayish with brown markings. The eggs, which are laid on the foliage, are pale green. The egg masses each contain from 10 to 50 or more eggs, which overlap one another like the scales of a fish. The hibernating first-stage larva, or caterpillar, is yellowish green when it first emerges in the spring. The head is blackish brown. The feeding larva becomes brown, and when full-grown it is dark reddish brown and nearly 1 inch in length. The head is dark brown or shining black. The pupa is about five-eighths inch long, pale brownish yellow when first formed, and later changes to dark reddish brown.

### **Its Seasonal History**

In the Northeastern States the moths emerge and deposit their eggs late in June and early in July and in the Lake States late in July. The eggs hatch in 8 to 12 days, and the young larvae crawl about, apparently without feeding, until they find a suitable place, under bark scales on the twigs or tree trunks, to spin their silken cases, or hibernacula. The larvae become active in the spring at about the time the buds of balsam fir and red spruce are swelling, which is late in April or early in May in the Northeastern States. They first tunnel the old needles and then enter the opening buds, where they feed on the new needles. As the new growth elongates, the larvae tie the tips of the twigs together to form small nests, in which they feed. The larvae become full-grown in June and pupate on the trees. The pupal period lasts only a few days and the moths emerge and lay their eggs a week or 10 days later.

### **Natural Agencies That Check Its Multiplication Between Outbreaks**

Inasmuch as the spruce budworm population remains at a low level for long periods between outbreaks, it is certain that such factors as adverse weather conditions, diseases, predators, and a large number of species of parasites play an important part in the natural control. When conditions for increase become favorable, however, epidemics break out and natural enemies are unable to control the insect.

## **Forest Management the Key to Spruce Budworm Control**

All past studies in eastern Canada and the United States have shown that most serious losses have occurred where there is an abundance of balsam fir, particularly where the trees are overmature, or in overmature or open-growth stands of jack pine. It is the consensus of opinion of entomologists and foresters who have intimate knowledge of the spruce budworm situation that the only practical solution for the region as a whole lies in the application of management practices to bring about forest conditions generally unfavorable to the budworm, thus preventing epidemic outbreaks or lessening their severity. This means particularly reduction in the proportion of balsam fir, especially when overmature. In general, practices desirable from a management standpoint are not favorable to the budworm.





